AQA GCSE Biology | 8461

SPECIFICATION POINT 4.1.1.5

Microscopy

Past-paper questions

Tier	**Higher**
Question groups	**15**
Available paper years	**2007–2024**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.1.1.5 Microscopy

Question 01

June 2007 | BLY1H | Original Q8 | Legacy

8 (a) What does the theory of evolution state?

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(2 marks)

(b) *Daphnia* are microscopic water fleas. Midge larvae prey on *Daphnia*. The midge larvae release a hormone into the water. *Daphnia* respond to these hormones by growing larger protective 'helmet'-like structures.

Scientists were surprised to observe that the offspring of *Daphnia* females who had been exposed to these hormones always had larger helmets than offspring whose mothers had never been exposed to the hormones. The offspring with the large helmets went on to produce offspring with large helmets.

Explain why the scientists' observations seem to contradict the theory of natural selection.

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(2 marks)

4

4.1.1.5 Microscopy

Question 02

January 2010 | BLY3H | Original Q3 | Legacy

3 A student removed three similar leaves from a plant. The student spread petroleum jelly (a waterproofing substance) on some of the leaves, as follows:

Leaf A: on the lower surface
Leaf B: on the upper surface
Leaf C: none.

The student placed each leaf in a separate beaker. He weighed each beaker at intervals. The results are shown in the table.

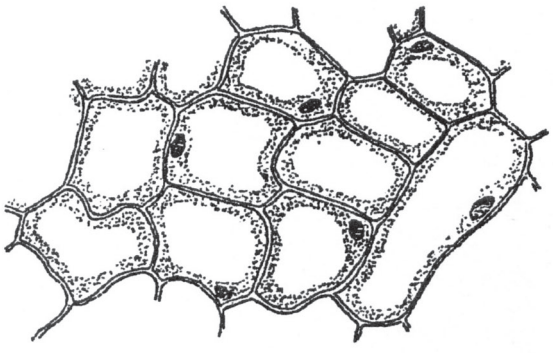
Time in hours	Mass of leaf + beaker in grams		
	Leaf A	Leaf B	Leaf C
0	50.00	55.01	51.99
1	49.99	54.95	51.90
3	49.97	54.90	51.85
5	49.95	54.86	51.80

3 (a) Which leaf, **A**, **B** or **C**, lost most water? ☐

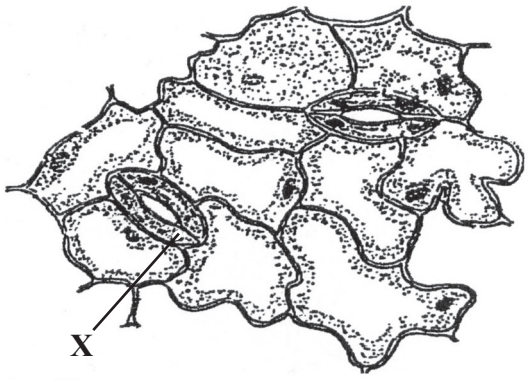
(1 mark)

3 (b) The diagram shows the appearance of the upper and lower surfaces of one of the leaves under a microscope.

Upper surface of leaf



Lower surface of leaf



3 (b) (i) Name cell **X**.....

(1 mark)

4.1.1.5 Microscopy

Question 02 · continued

for mark

3 (b) (ii) The petroleum jelly had a greater effect when it was spread on the lower surface than when it was spread on the upper surface.

Use information from the diagram to explain why.

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(2 marks)

4

Turn over for the next question

4.1.1.5 Microscopy

Question 03

March 2010 | BLY1AP | Original Q9 | Legacy

QUESTION NINE

Some diseases are caused by viruses. Each type of virus only infects and causes the disease in one species of organism. One of the reasons for this is that a protein on the virus surface only matches with the cells of one particular species of organism.

9A Why does the flu virus make us feel ill?

1 The virus itself produces a toxin.

2 The virus damages the cells in which it reproduces.

3 The large number of viruses increases our temperature.

4 Viruses reproduce rapidly as soon as they are breathed in.

9B Bird flu is caused by a virus.

What might happen to the existing form of bird flu virus that would allow it to infect humans and cause flu in Britain?

1 an increase in the number of birds with the bird flu virus

2 a new strain of bird flu entering Britain

3 a change in the antibody which the bird flu virus carries

4 a change in the protein on the virus surface

Question 03 · continued

Humans produce antibodies against viruses.

A scientist investigated the effect of a virus infection on the antibody concentration in a person's blood.

The person was infected by day 3.

Time in days	**1**	**4**	**7**	**10**	**13**	**16**	**19**	**22**	**25**
Antibody concentration in mg per 100 cm^3 of blood	5.1	6.0	10.4	35.9	55.9	50.2	48.8	32.7	10.0

9C Which conclusion can be drawn from the data?

1 This virus did not reproduce until the 10th day.

2 Antibody production by the body continues to rise until the patient recovers.

3 The patient had recovered by the 25th day.

4 Antibody production by the body rises to a peak after an infection and then declines.

9D Another scientist repeated the investigation but could not measure the antibody concentration directly. Instead, he made measurements using a blood cell counter. He counted the white blood cells using a microscope with an automatic cell counter. A colleague said that he would not trust this data as much as measuring the antibody concentration with a machine.

Which of the reasons below best accounts for his colleague's attitude?

1 There is no relationship between the number of white cells and the concentration of antibodies.

2 Counting white cells is a less sensitive method than measuring antibody concentration with a machine.

3 The antibody measuring machine is more expensive to buy and run.

4 Reading the cell counter is less accurate than reading the scale on the antibody machine.

END OF TEST

4.1.1.5 Microscopy

Question 04

June 2011 | BLY2H | Original Q1 | Legacy

1 Cells contain a solution of salts and sugars.

A student is investigating how cells change when they are put into water.

1 (a) The student:

- looks at a plant cell using a microscope
- adds water to the cell.

The plant cell swells up.

Explain why, as fully as you can.

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(3 marks)

1 (b) When **animal** cells are put in water, they swell up, and then burst.
When **plant** cells are put in water, they swell up, but do **not** burst.

How does the structure of plant cells prevent them from bursting?

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.....

(1 mark)

4

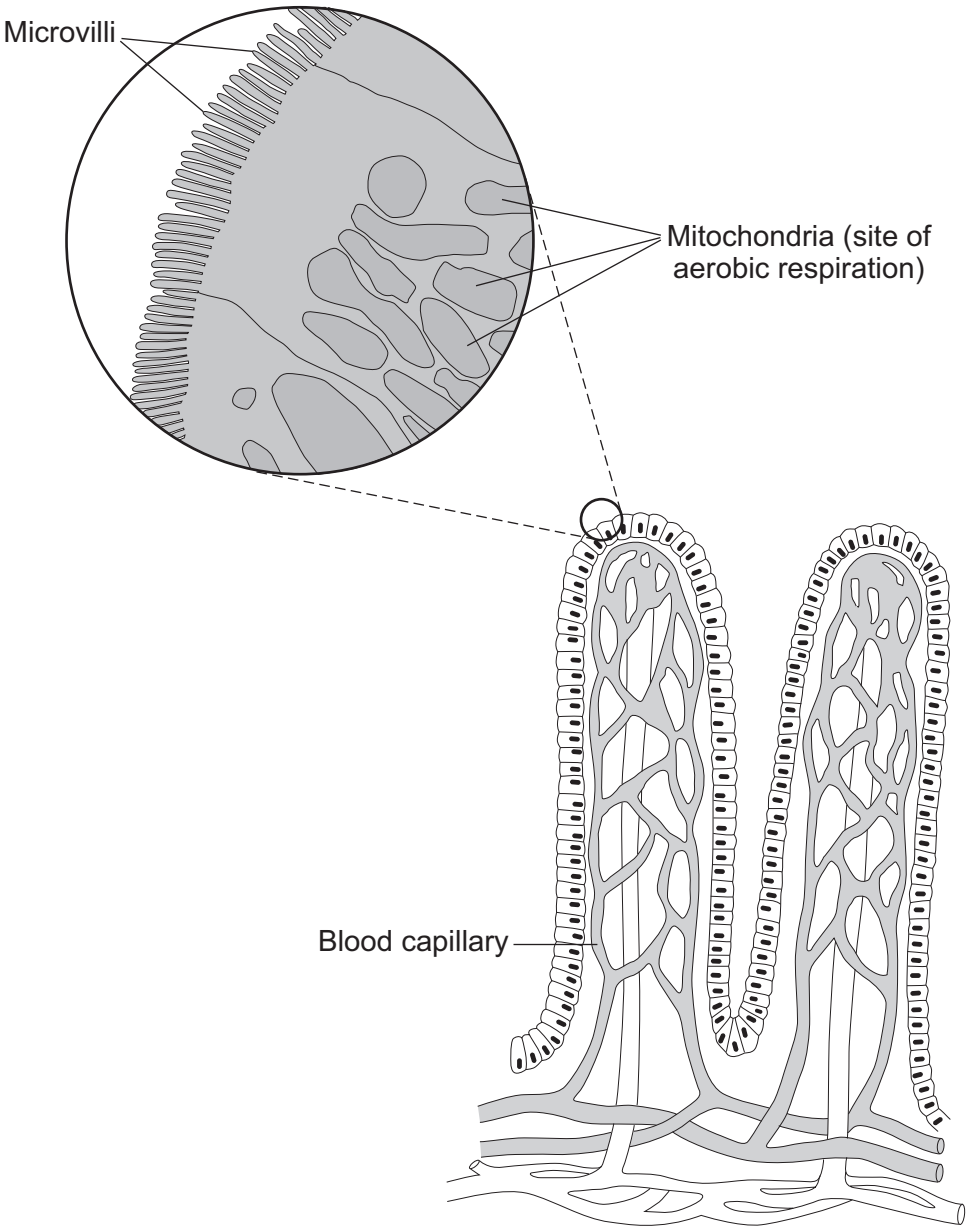
4.1.1.5 Microscopy

Question 05

June 2011 | BLY3H | Original Q5 | Legacy

5 The villi of the small intestine absorb the products of digestion.

The diagram shows two villi. It also shows parts of some of the surface cells of a villus, as seen with an electron microscope.



4.1.1.5 Microscopy

Question 05 · continued

Describe and explain how the villi are adapted to maximise the rate of absorption of the products of digestion.

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(5 marks)

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4.1.1.5 Microscopy

Question 06

June 2011 | BLY3H | Original Q6 | Legacy

6 (a) In industry, microorganisms are grown in fermenters to make useful products.

Name **one** useful product that can be made using microorganisms grown in a fermenter.

.....

(1 mark)

6 (b) Scientists grew one species of bacterium in a fermenter.
The scientists added glucose and other nutrients to the culture medium in the fermenter.

To study the growth of the bacteria, the scientists removed a 1 cm^3 sample of the culture medium from the fermenter once every 5 hours. They added a measured volume of water to dilute the sample by a known amount.

The scientists used two different methods to find the number of bacteria in each sample.

Method A

The scientists:

- added 0.1 cm^3 of the diluted culture to a Petri dish
- poured molten agar into the Petri dish and swirled the dish to mix the contents
- placed the Petri dish in an incubator at 35 °C for 24 hours
- counted the number of colonies of bacteria that had grown in the Petri dish.

Method B

The scientists:

- put some of the diluted sample into a special counting chamber on a microscope
- counted the number of bacteria found in a small volume of the diluted culture.

6 (b) (i) In each method, the scientists diluted the samples that they removed from the fermenter.

Why did they need to do this?

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(1 mark)

4.1.1.5 Microscopy

Question 06 · continued

6 (b) (ii) In **Method A**, the scientists counted colonies of bacteria that had grown in a Petri dish. Explain how counting colonies helped the scientists to find the number of bacteria in a sample.

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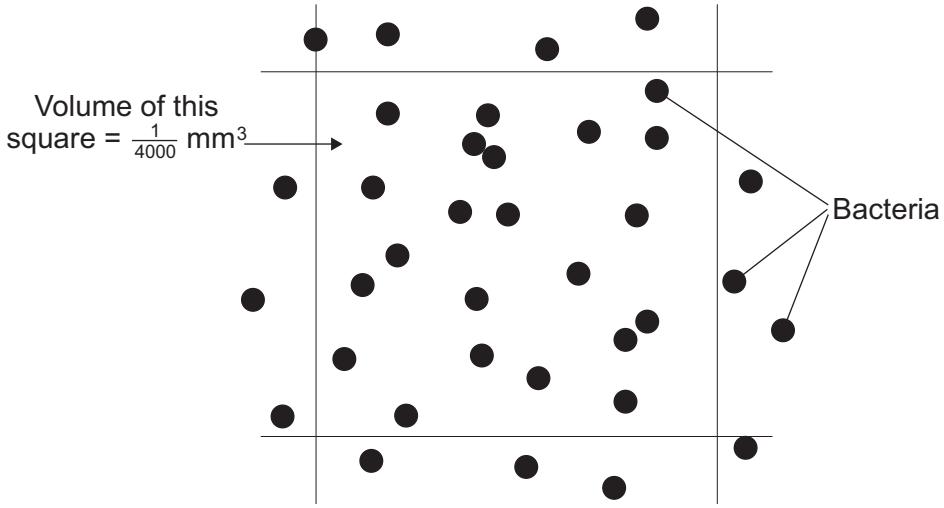
(2 marks)

6 (c) The scientists wanted to find the number of bacteria in a sample of culture medium by using **Method B**.

The sample of culture medium was diluted to $\frac{1}{100}$ of its original concentration.

The diluted sample was then placed in the counting chamber.

The diagram shows part of the counting chamber as seen under a microscope.



Complete the following calculations to find how many bacteria there were in 1 mm^3 of the undiluted sample of culture medium.

Use information from the diagram.

Number of bacteria in $\frac{1}{4000}$ mm^3 of **diluted** culture medium = ...

Number of bacteria in 1 mm^3 of **diluted** culture medium = ...

Number of bacteria in 1 mm^3 of **undiluted** culture medium = ...

(2 marks)

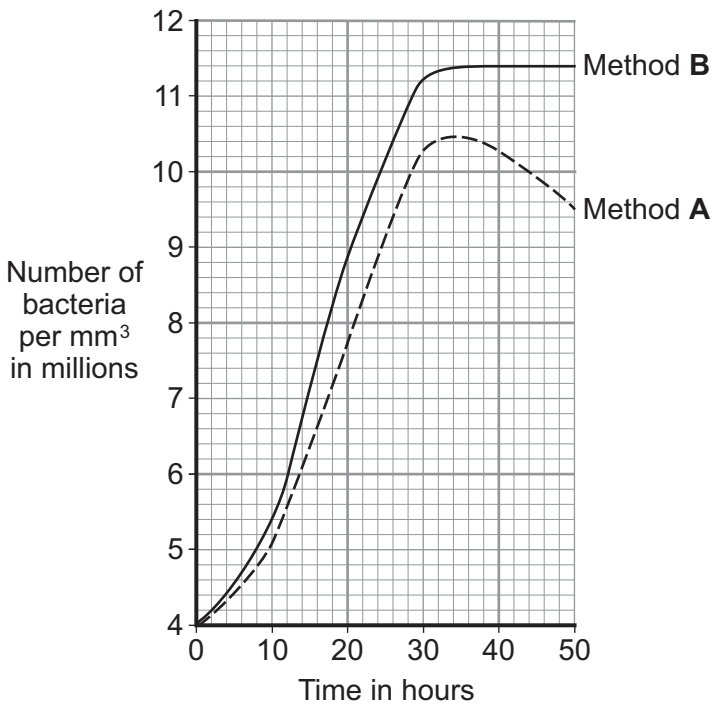
Question 6 continues on the next page

4.1.1.5 Microscopy

Question 06 · continued

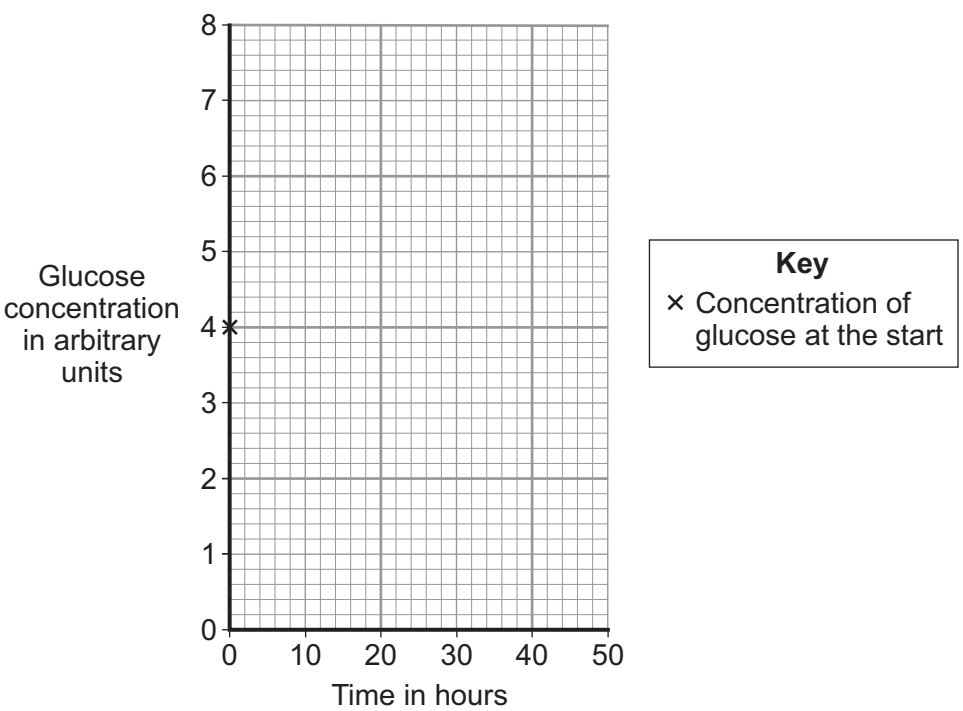
6 (d) The scientists grew the bacteria for 50 hours.
Graph 1 shows the scientists' results.

Graph 1



Graph 2 is not complete.
The concentration of glucose in the fermenter at the start of the investigation was 4 units.

Graph 2



4.1.1.5 Microscopy

Question 06 · continued

6 (d) (i) **On Graph 2**, draw a line to show how the glucose concentration would change over the 50 hours of the investigation.

(2 marks)

6 (d) (ii) Explain the shape of the growth curve that was obtained using **Method A**.

Use information from your answer to part (d)(i).

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(3 marks)

6 (d) (iii) Why did **Method B** give higher values for the number of bacteria than **Method A**?

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(1 mark)

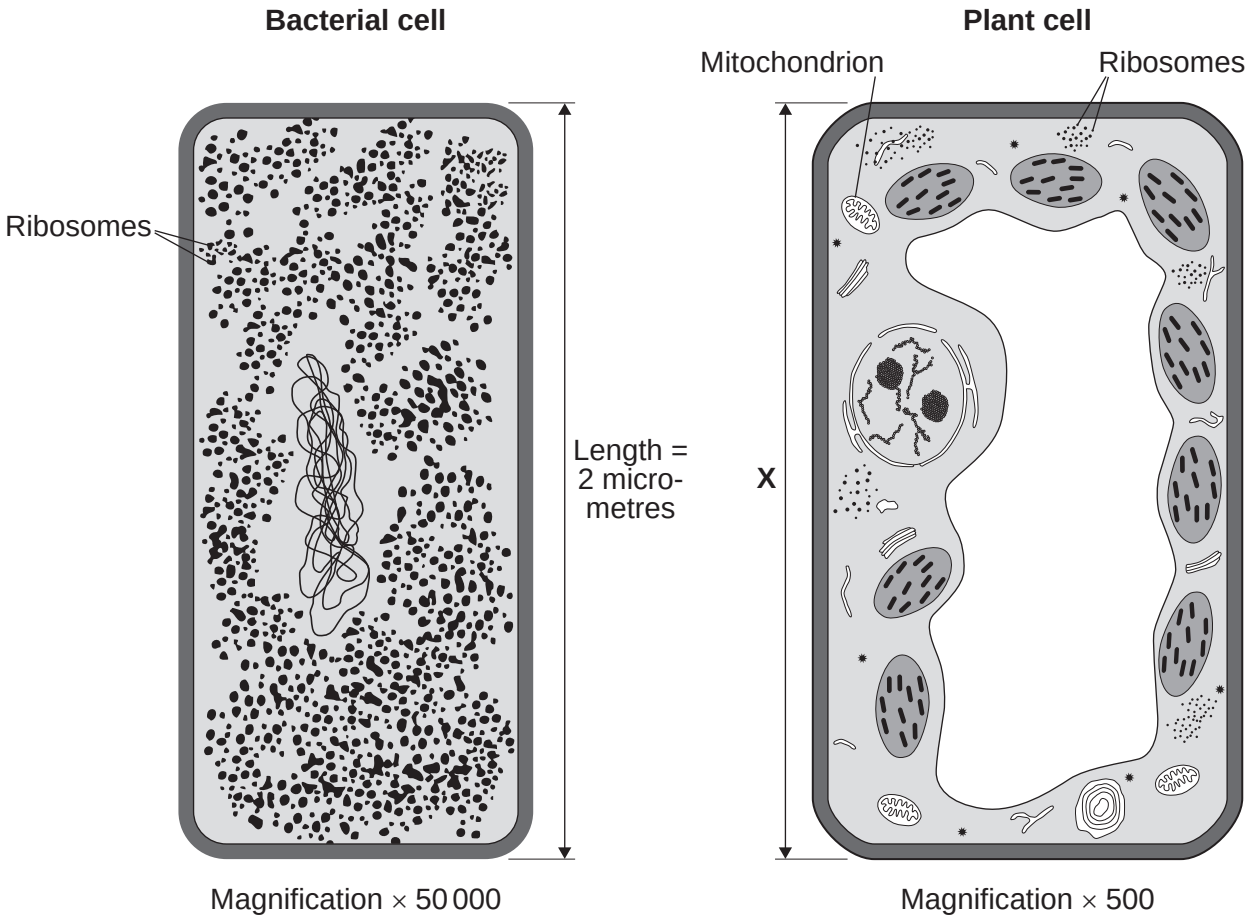
12

4.1.1.5 Microscopy

Question 07

June 2012 | BL2HP | Original Q2 | Legacy

2 The diagram shows two cells, a bacterial cell and a plant cell.



2 (a) (i) Both the bacterial cell and the plant cell contain ribosomes.

What is the function of a ribosome?

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(1 mark)

2 (a) (ii) The plant cell contains mitochondria but the bacterial cell does **not** contain mitochondria.

Give **one** other way in which the plant cell is different from the bacterial cell.

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(1 mark)

4.1.1.5 Microscopy

Question 07 · continued

2 (b) (i) Both cells are drawn the same length, but the magnification of each cell is different.

The real length of the bacterial cell is 2 micrometres.
Calculate the real length, **X**, of the plant cell. Give your answer in micrometres.

Show clearly how you work out your answer.

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X = ... micrometres
(2 marks)

2 (b) (ii) Most mitochondria are about 3 micrometres in length.

The plant cell contains mitochondria but the bacterial cell does **not** contain mitochondria.

Use your answer to part **(b)(i)** and the information in the diagram to suggest why.

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(1 mark)

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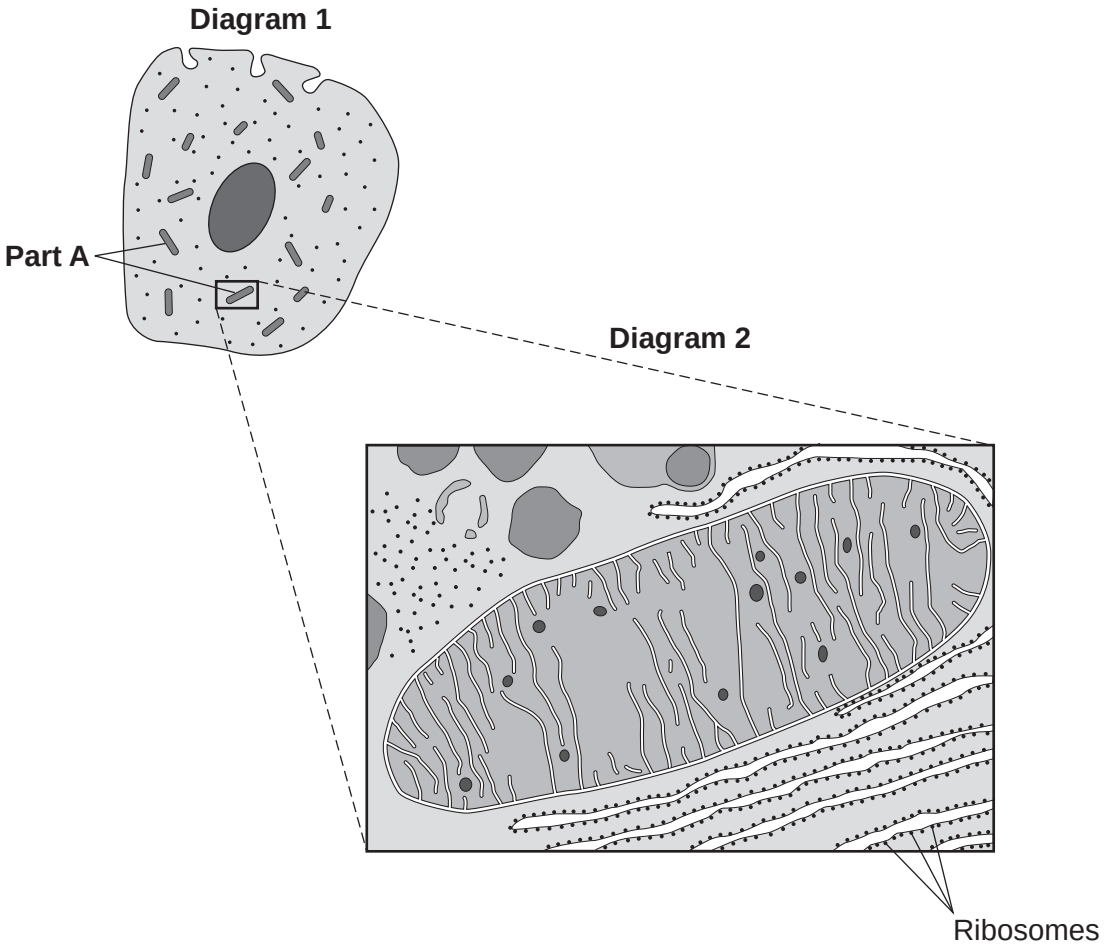
4.1.1.5 Microscopy

Question 08

January 2013 | BL2HP | Original Q3 | Legacy

3 **Diagram 1** shows a cell from the pancreas.

Diagram 2 shows part of the cell seen under an electron microscope.



Part **A** is where most of the reactions of aerobic respiration happen.

3 (a) (i) Name part **A**.

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(1 mark)

3 (a) (ii) Complete the equation for aerobic respiration.

glucose + oxygen ⟶ ..... + ... (+ energy)

(2 marks)

4.1.1.5 Microscopy

Question 08 · continued

3 (a) (iii) Part **A** uses oxygen.

Explain how oxygen passes from the blood to part **A**.

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(3 marks)

3 (b) The pancreas cell makes enzymes.

Enzymes are proteins.

Describe how the ribosomes and part **A** help the cell to make enzymes.

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(3 marks)

9

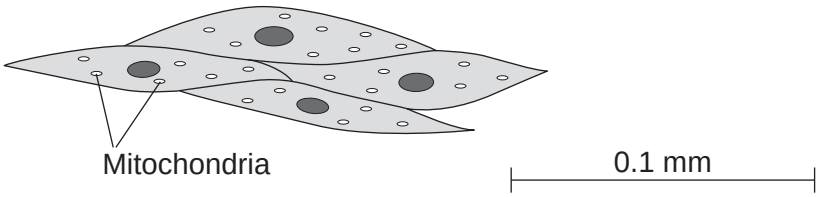
4.1.1.5 Microscopy

Question 09

June 2015 | BL2HP | Original Q4 | Legacy

4 **Figure 6** shows some muscle cells from the wall of the stomach, as seen through a light microscope.

Figure 6



4 (a) Describe the function of muscle cells in the wall of the stomach.

[2 marks]

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4 (b) **Figure 6** is highly magnified.

The scale bar in **Figure 6** represents 0.1 mm.

Use a ruler to measure the length of the scale bar and then calculate the magnification of **Figure 6**.

[2 marks]

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Magnification = ... times

4.1.1.5 Microscopy

Question 09 · continued

4 (c) The muscle cells in **Figure 6** contain many mitochondria.

What is the function of mitochondria?

[2 marks]

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4 (d) The muscle cells also contain many ribosomes. The ribosomes cannot be seen in **Figure 6**.

4 (d) (i) What is the function of a ribosome?

[1 mark]

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4 (d) (ii) Suggest why the ribosomes **cannot** be seen through a light microscope.

[1 mark]

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8

4.1.1.5 Microscopy

Question 10

June 2019 | 8461/1H | Original Q1

0 1 **Figure 1** shows an animal cell viewed using a microscope.

Figure 1



0 1 . 1 The cell contains a nucleus.

What is the function of the nucleus?

[1 mark]

0 1 . 2 Name **one** type of cell that does **not** contain a nucleus.

[1 mark]

4.1.1.5 Microscopy

Question 10 · continued

0 1 . 3 Draw a simple diagram of the cell in **Figure 1**.

Label **two** parts of the cell.

[2 marks]

0 1 . 4 Name **one** structure found in a plant cell but **not** found in an animal cell.

[1 mark]

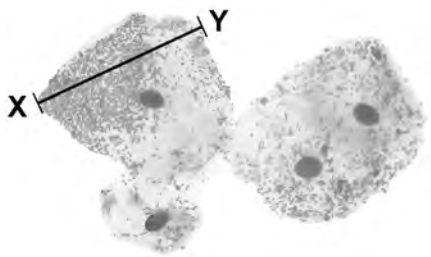
Question 1 continues on the next page

4.1.1.5 Microscopy

Question 10 · continued

Figure 2 shows some different cells.

Figure 2



0 1 . 5 The real length from point **X** to point **Y** is 0.06 mm

Calculate the magnification.

Use the equation:

$$\text{magnification} = \frac{\text{size of image}}{\text{real size of object}}$$

[3 marks]

Magnification = ×

4.1.1.5 Microscopy

Question 10 · continued

0 1 . 6 The cells shown in **Figure 2** were viewed using a light microscope.

Give **two** advantages of using an electron microscope instead of a light microscope.

[2 marks]

1 _____

_____

2 _____

_____

10

Turn over for the next question

4.1.1.5 Microscopy

Question 11

November 2020 | 8461/1H | Original Q7

0 7 Monoclonal antibodies (mAbs) are usually made using mouse lymphocytes.

Candida albicans infection produces serious symptoms in patients with a poor immune system.

Recently scientists have produced mAbs to *Candida albicans* using human lymphocytes produced naturally after an infection.

0 7 . 1 *Candida albicans* lives in the throat of infected patients.

A sample is taken from the throat of a patient with a suspected *Candida albicans* infection.

The sample is transferred onto a microscope slide.

Describe how the mAbs and a fluorescent dye could be used to see any *Candida albicans* pathogens on the slide.

[3 marks]

4.1.1.5 Microscopy

Question 11 · continued

In a laboratory the human lymphocyte mAbs were injected into animals infected with *Candida albicans*.

The mAbs caused increased phagocytosis of the *Candida albicans* pathogens.

Doctors intend to start a trial to give the mAbs to patients severely ill with *Candida albicans.*

0 7 . 2 Explain how increased phagocytosis of the *Candida albicans* pathogen will help the patient.

[2 marks]

Question 7 continues on the next page

4.1.1.5 Microscopy

Question 11 · continued

0 7 . 3 It has been shown that this mAbs treatment is effective in the laboratory using both:

- infected tissue culture cells
- infected live animals.

The mAbs treatment for *Candida albicans* is now ready for clinical trials on people.

Describe how the clinical trials should be carried out.

[6 marks]

4.1.1.5 Microscopy

Question 11 · continued

0 7 . 4 Scientists have also used human lymphocytes to make mAbs to other pathogens and to some types of cancer cells.

Suggest **one** reason why these new mAbs have been more successful in treating diseases in humans than mAbs made using mice.

[1 mark]

12

4.1.1.5 Microscopy

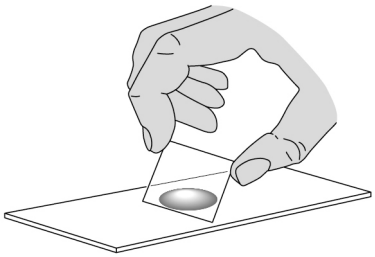
Question 12

November 2021 | 8461/1H | Original Q1

0 1 A student prepared some animal cells to view using a microscope.

Figure 1 shows the student preparing the cells.

Figure 1



0 1 . 1 Name **two** pieces of laboratory equipment the student could have used to **prepare** cells to view using a microscope.

[2 marks]

1 _____

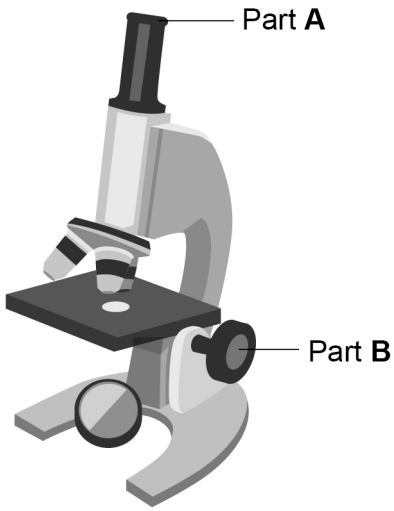
2 _____

4.1.1.5 Microscopy

Question 12 · continued

Figure 2 shows the student's light microscope.

Figure 2



0 1 . 2 Name part **A**.

[1 mark]

0 1 . 3 What is the function of part **B**?

[1 mark]

0 1 . 4 The student tried to look at the cells using the microscope.

Suggest **one** reason why the student could **not** see any cells when looking through part **A**.

[1 mark]

Question 1 continues on the next page

4.1.1.5 Microscopy

Question 12 · continued

0 1 . 5 Red blood cells are specialised animal cells.

Compare the structure of a red blood cell with the structure of a plant cell.

[6 marks]

0 1 . 6 When placed into a beaker of water:

- a red blood cell bursts
- a plant cell does **not** burst.

Explain why the red blood cell bursts but the plant cell does **not** burst.

[2 marks]

13

4.1.1.5 Microscopy

Question 13

June 2022 | 8461/1H | Original Q3

0 3 A student prepared some onion cells.

The student viewed the onion cells using a light microscope.

This is the method used.

1. Cut an onion into pieces using a sharp knife.
2. Peel off a thin layer of onion epidermis from one piece of onion.
3. Place the onion epidermis onto a microscope slide in a single flat layer.
4. Add three drops of iodine solution.
5. Slowly lower a cover slip at an angle onto the onion epidermis.
6. Place the slide on the stage of the microscope.

0 3 . 1 **Table 4** shows a risk assessment for this experiment.

Complete **Table 4**.

[2 marks]

Table 4

Hazard	Risk	Plan to minimise risk
Iodine solution is an irritant	May cause allergic reaction or skin rash	
Sharp knife		

4.1.1.5 Microscopy

Question 13 · continued

0 3 . 2 Give a reason for each of the following steps in the method.

[3 marks]

A **thin layer** of onion epidermis is used.

Iodine solution is added to the onion epidermis.

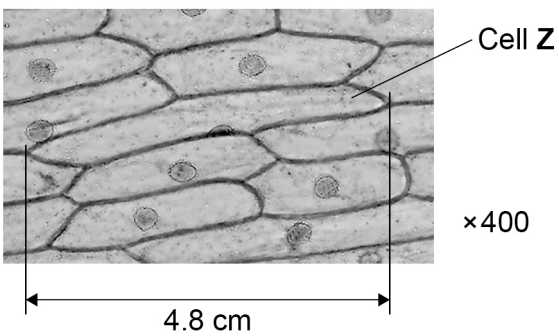
The cover slip is lowered onto the onion epidermis **at an angle**.

Question 3 continues on the next page

4.1.1.5 Microscopy

Figure 3 shows what the student saw under the microscope at a magnification of ×400.

Figure 3



0 3 . 3 The length of cell **Z** in **Figure 3** is 4.8 cm.

Calculate the real length of cell **Z**.

Give your answer in micrometres (μm).

[5 marks]

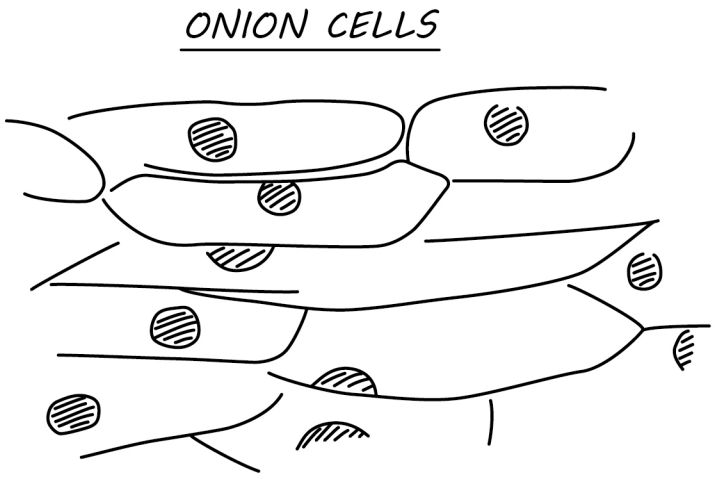
Real length of cell **Z** = _____ μm

4.1.1.5 Microscopy

Question 13 · continued

Figure 4 shows the student's drawing of **Figure 3**.

Figure 4



0 3 . 4 Give **two** ways the student could improve the drawing in **Figure 4**.

[2 marks]

1 _____

_____

2 _____

_____

0 3 . 5 Onion cells can be seen using an electron microscope.

Give **two** ways onion cells would look different when seen using an electron microscope.

[2 marks]

1 _____

_____

2 _____

_____

14

4.1.1.5 Microscopy

Question 14

June 2022 | 8461/2H | Original Q7

0 7 A scientist found a polluted pond which had a new type of blue algae in the water.

The blue colour of the algae was caused by a mutation.

0 7 . 1 What is a mutation?

[1 mark]

Question 7 continues on the next page

4.1.1.5 Microscopy

Question 14 · continued

The scientist measured the number of blue algal cells in a sample of the pond water.

The scientist used a special slide which has a counting grid.

This is the method used.

1. Dilute 2.5 cm^3 of pond water to a volume of 10 cm^3 with distilled water.
2. Place a drop of the diluted pond water on the special slide, as shown in **Figure 8**.
3. Place a thick coverslip over the diluted pond water to give a depth of 0.1 mm of pond water.
4. Use a microscope to count the number of algal cells in a 0.2 mm × 0.2 mm square on the counting grid.

Figure 8 shows a side view of the special slide.

Figure 8

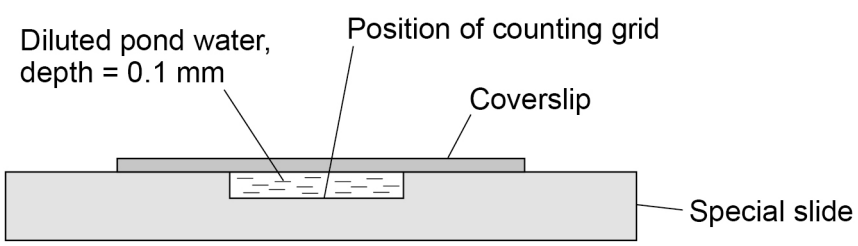
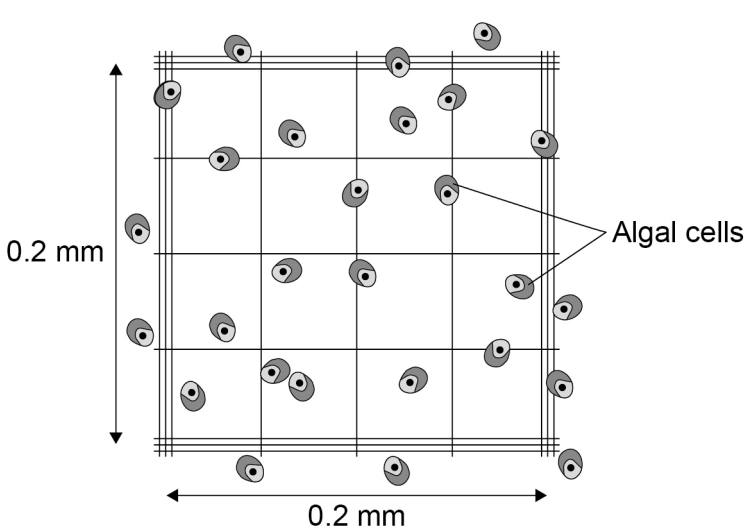


Figure 9 shows the view of the counting grid through a microscope.

Figure 9



4.1.1.5 Microscopy

Question 14 · continued

0 7 . 2 How many algal cells are in the 0.2 mm × 0.2 mm square in **Figure 9**?

Use the following procedure:

- Count all cells that are completely within the 0.2 mm × 0.2 mm square in the counting grid.
- Count cells that are touching the left side or the lower side of the square.
- Do **not** count cells that are touching the right side or the top side of the square.

[1 mark]

Number of algal cells in the 0.2 mm × 0.2 mm square = _____

0 7 . 3 One week later the scientist repeated the test and counted 14 cells on the 0.2 mm × 0.2 mm counting grid.

Calculate the number of algal cells in 1.0 mm^3 of **undiluted** pond water.

Use the scientist's second count of 14 cells.

[6 marks]

Number of algal cells in 1.0 mm^3 of undiluted pond water = _____

Question 7 continues on the next page

4.1.1.5 Microscopy

Question 14 · continued

0 7 . 4 Suggest why the scientist diluted the pond water before placing it on the special slide.

[1 mark]

0 7 . 5 A student repeated the scientist's method.

The student used a thin coverslip over the diluted pond water instead of the thick coverslip.

The liquid pulled the thin coverslip downwards slightly.

Explain how the use of the thin coverslip would affect the results for the cell count.

[2 marks]

11

4.1.1.5 Microscopy

Question 15

June 2024 | 8461/1H | Original Q8

0 8 Cancer is caused by changes in cells that result in uncontrolled cell division.

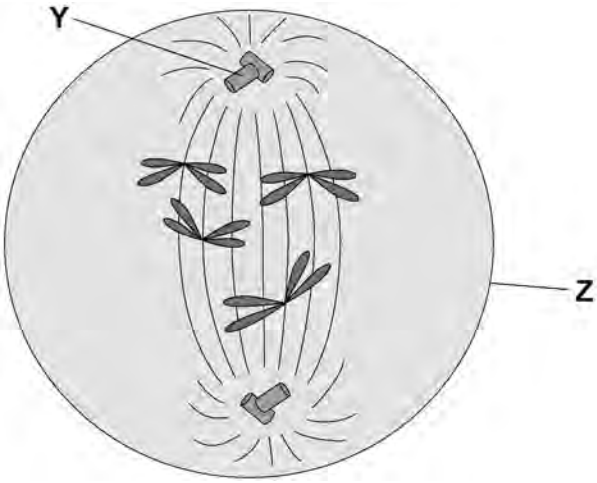
0 8 . 1 Before a cell begins to divide, its DNA replicates to form two copies of each chromosome.

Describe **one other** change that occurs in a cell **before** the cell begins to divide.

[1 mark]

Figure 8 shows a cell during one of the stages of cell division.

Figure 8



0 8 . 2 Name structure **Z** in **Figure 8**.

[1 mark]

4.1.1.5 Microscopy

Question 15 · continued

0 8 . 3 Structure **Y** in **Figure 8** is a cylinder.

For structure **Y**:

- real volume = 24 500 000 nm^3
- real radius = 125 nm.

The length of a cylinder is calculated using the equation:

$$\text{length} = \frac{\text{volume}}{\pi \times \text{radius}^2}$$

The length of the image of structure **Y** in **Figure 8** is 4 mm.

Calculate the magnification of structure **Y** in **Figure 8**.

Use $\pi = 3.14$

[6 marks]

Magnification = × _____

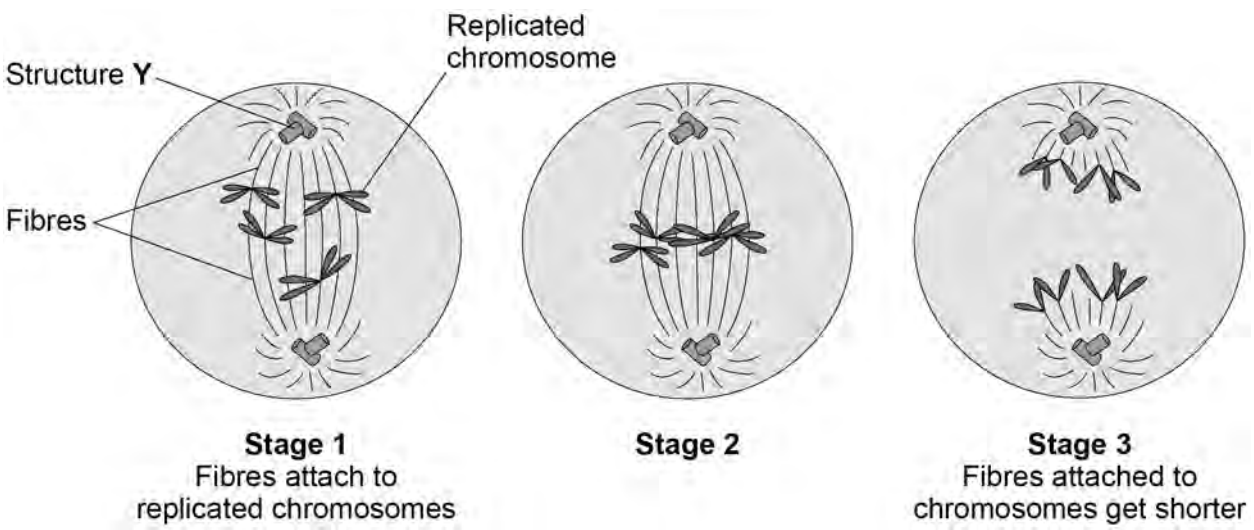
Question 8 continues on the next page

4.1.1.5 Microscopy

Question 15 · continued

Figure 9 shows some of the stages of cell division.

Figure 9



Some cancer drugs prevent cell division.

Drug **X** prevents the fibres from attaching to the replicated chromosomes in **stage 1**.

0 8 . 4 Explain why a cell **cannot** complete division when affected by drug **X**.

[2 marks]

4.1.1.5 Microscopy

Question 15 · continued

0 8 . 5 Give the reason why a drug that stops cell division helps to treat cancer.

[1 mark]

0 8 . 6 New cancer drugs are tested in clinical trials.

Preclinical testing happens before clinical trials.

What is involved in preclinical testing of drugs?

[1 mark]

Tick (✓) **one** box.

- Testing the drugs for side effects ☐
- Testing the drugs on live tissues in a laboratory ☐
- Testing the drugs to find the optimum dose ☐
- Testing the drugs with chemicals in a laboratory ☐

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